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ABSTRACT

We need to find out the extent to which individual differences, social class differences and race differences in rates of cognitive development, and differential patterns of relative strength and weakness are attributable to genetically conditioned biological growth factors. The answers to this question might imply differences in our approach to improving the education of all children, particularly those we call the disadvantaged, for many of whom school is now a frustrating and unrewarding experience. Dealing with children as individuals is not the greatest problem. It is in our concern about the fact that, when we do so, we have a differentiated educational program, and children of different socially identifiable groups may not be proportionately represented in different programs. Many environmentally caused differences can be minimized or eliminated, given the resources and the will of society. The differences that remain are a challenge for public education. It is the responsibility of educators to create a diversity of instructional arrangements best suited to the full range of educational differences. (Author/JM)

CAN WE AND SHOULD WE STUDY RACE DIFFERENCES?

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Most persons experience some difficulty in discussing the topic of race differences in intelligence - a difficulty over and above that which is ordinarily inherent in the scientific study of any complex phenomenon. There is an understandable reluctance to come to grips with the problem, to come to grips with it, that is to say, in the same straightforward way that we would try to approach the investigation of any other problems in the behavioral sciences. This reluctance is manifested in a variety of "symptoms" found in most writings and discussions of the psychology of race differences, particularly differences in mental ability: a tendency to remain on the remotest fringes of the subject, to sidestep central questions; to blur the issues and tolerate a degree of vagueness in definitions, concepts, and inferences that would be unseemly in any other realm of scientific discourse; to express an unwarranted degree of skepticism about reasonably well established quantitative methods and measurements; to deny or belittle already generally accepted facts - accepted, that is, when brought to bear on inferences outside the realm of race differences; to demand practically impossible criteria of certainty before even seriously proposing or investigating genetic hypotheses, as contrasted with extremely uncritical attitudes toward purely environmental hypotheses, a failure to distinguish clearly between scientifically answerable aspects of the question and the moral, political, and social policy issues; a tendency to beat dead horses and

to set up straw men on what is represented as the genetic side of the argument; appeals to the notion that the topic is either really too unimportant to be worthy of scientific curiosity or too complex, or too difficult, or even forever impossible for any kind of research to be feasible, or that answers to key questions are fundamentally "unknowable" in any scientifically acceptable sense; and, finally, the complete denial of intelligence and race as realities, or as quantifiable attributes, or as variables capable of being related to one another, thereby dismissing the subject altogether.

These tendencies will be increasingly overcome the more widely and openly the subject is discussed among scientists and scholars. As some of the taboos against the public discussion of the topic fall away, the issues will become clarified on a rational basis, we will come to know better just what we do and do not yet know about the subject, and we will be in a better position to deal with it objectively and constructively.

Is Intelligence an Attribute?

Intelligence is an attribute of persons. Probably for as long as man has been on earth it has been a common observation that persons differ in brightness, in speed of learning, in ability to solve problems, and so on. Parents, teachers, and employers are able roughly to rank children

and adults in terms of a subjective impression of brightness or capability, and there is a fairly high agreement among different observers in the rank order they assign in the same groups of children. It is helpful to think of the subjective perception of intelligence as analogous to the subjective perception of temperatures, which is also an attribute. Before the invention of the thermometer, temperature was a matter of subjective judgment. The invention of the thermometer made it possible to objectify the attribute of temperature, to quantify it, and to measure it with a high degree of reliability. With some important qualifications, the situation is similar in the case of intelligence tests. The most essential difference is that intelligence, unlike temperature, is multidimensional rather than unidimensional. That is to say, there are different varieties of intelligence, so that persons do not maintain the same rank order of ability in every situation or test that we may regard as indicative of intelligence. It so happens that from among the total spectrum of human behaviors that can be regarded as indicative of some kind of "mental ability" in the broadest sense, we have focused on one part of this spectrum in our psychological concept of intelligence. We have emphasized the abilities characterized as conceptual learning, abstract or symbolic reasoning, and abstract or verbal problem solving. These abilities were most emphasized in the composition of intelligence tests because these were the abilities most relevant to the traditional school curriculum and the first practical intelligence tests were devised to predict scholastic performance. When tests were devised to predict occupational performance, they naturally had a good deal in common with the tests devised for scholastic prediction, since the educational system

is intimately related to the occupational demands of a given society. Much the same abilities and skills that are important in schooling, therefore, are important also occupationally. Thus, we find that in industrialized countries practically all intelligence tests, scholastic aptitude tests, military classification tests, vocational aptitude tests, and the like, are quite similar in composition and that the scores obtained on them are all quite substantially intercorrelated. In short, there is a large general factor, or g, which the tests share in common and which principally accounts for the variance among individuals. When tests are devised to measure this g factor as purely as possible (i.e. in a factor analysis including a host of other tests it will have nearly all of its variance loaded on the general factor common to all the other tests and have little or no variance loaded on factors found only in certain tests {special factors} or factors found only in small groups of tests {group factors}), examination of their item content leads to the characterization of it as requiring an ability for abstract reasoning and problem solving. Raven's Progressive Matrices Test is an example of such a test. Tests having quite diverse forms can have equally high loadings on the g factor - for example, the verbal similarities and block design tests of the Wechsler Intelligence Scales are both highly loaded on g. Tests of g can be relatively high or relatively low in degree of "culture fairness." (The question "In what way are a wheel and a penny alike?" is probably more culture fair than the question "In what way are an oboe and a bassoon alike?") In short, it is possible to assess essentially the same intelligence by a great variety of means.

Standard IQ tests measure the kinds of behavior in abstract and verbal problem situations that we call abstract reasoning ability. These

tests measure more of g - the factor common to various forms of intelligence tests - than of any of the other more special ability factors, such as verbal fluency, spatial - perceptual ability, sensory abilities, or mechanical, musical, or artistic abilities, or what might be called social judgment or sensitivity. But a test that measured everything at once would not be very useful. IQ tests do reliably measure one important, though limited, aspect of human performance. The IQ qualifies as an appropriate datum for scientific study. If we are to study intelligence, we are ahead if we can measure it. Our measure is the IQ, obtained on tests which meet certain standards, one of which is a high g loading when factor analyzed among other tests. To object to this procedure by arguing that the IQ cannot be regarded as being interchangeable with intelligence, or that intelligence cannot really be measured, or that IQ is not the same as intelligence, is to get bogged down in a semantic morass. It is equivalent to arguing that a column of mercury in a glass tube cannot be regarded as synonymous with temperature, or that temperature cannot really be measured with a thermometer. If the measurements are reliable and reproducible, and the operations by which they are obtained can be objectively agreed upon, this is all that need be required for them to qualify as proper scientific data. We know that individually administered IQ tests have quite high reliability; the reliability coefficients are around .95, which means that only about 5 percent of the total individual differences variance is attributable to measurement error. And standard group administered tests have reliabilities close to .90.

The standard error of measurement (which is about $\pm$ 5 for the Stanford-Binet and similar tests) must always be taken into consideration when considering any individual's score on a test. But it is actually quite unimportant in comparison of the means of large groups of subjects, since errors of measurement are more or less normally distributed about zero and they cancel out when N is large. The reliability (i.e., consistency or freedom from errors of measurement) per se of the IQ is really not seriously at issue in making comparisons between racial groups. If the samples are large, the mean difference between groups will not include the test's errors of measurement.

The validity or importance of the measures derives entirely from their relationship to other variables and the importance we attach to them.

The IQ correlates with many external crieria, and at the most general level it may be regarded as a measure of the ability to compete in our society in ways that have economic and social consequences for the individual. In the first place, the IQ accords with parents' and teachers' subjective assessments of children's brightness, as well as with the evaluations of children's own peers. In terms of assessments of scholastic performance, whether measured in terms of school grades, teachers' ratings, or objective tests of scholastic achievement, the IQ accounts for more of the individual differences variance than any other single measurable attribute of the child. IQ accounts for about 50 percent of the variance in scholastic achievement at any single grade level, and over the course of several years or more of schooling it accounts for over 70 percent of the variance in overall scholastic performance.

Since considerably less than 100 percent of the varaince is accounted for, it means the IQ is not an infallible predictor of the performance of any one individual. When used for individual diagnosis it must be evaluated in terms of many other factors in the child's makeup and background and condition at the time of testing, and even then not too much stock should be placed in the IQ in predicting for the individual case, since the predictive validity of the IQ is not sufficiently high to override the effects of possibly unassessed traits or unpredictable unusual future circumstances which may radically alter the course of the individual's development or performance in a statistically small proportion of cases. Thus, I am emphasizing the importance of evaluating the IQ somewhat differently when used for individual diagnosis and prediction than when used in making statistical predictions on large groups of individuals. It is somewhat analogous to actuarial predictions of insurance risks. Predictions for large groups classified by various criteria can be made with high degrees of certainty, while predictions for individual cases are highly uncertain.

Recently I received a letter from a high school senior who described himself as coming from a disadvantaged background. He had a strong desire to go on to college in hopes of becoming a lawyer, and he was wondering about his IQ and how much stock he should put in it in deciding his further course. I doubt if there is much more sense in worrying about one's own IQ than in worrying about the age at which one will die, as predicted by the insurance company's actuarial tables. Among other things, I wrote the following to my student inquirer: "My own attitude toward tests, when I was a student, was not to give much thought to them but simply to set my sights on what seemed to me a realistic goal and then do my best to achieve

it. You find out from those who have already made it what you have to know, what you have to be able to do, what skills you need to develop, and you set about doing these things just as you'd go about doing any kind of job that you know has to be done. If you set your goals too low, it's too easy and you won't develop your potential. If you set goals that are unrealistically high, you become discouraged. I recommend one step at a time, each step being something you really think you can achieve if you really work for it. When you have made the first step successfully, then you will have a better idea of how to take the next step. That way, if you have whatever it takes, you'll make it; if you haven't got whatever it takes; you'll find this out. But you'll never really know without trying your best. I wouldn't let any kind of test score determine what I try for. The reality of your own performance in meeting the competition in striving toward your goals is the only real test. I believe this approach gives one the best chances of finally doing what he is best suited for, and this is one of the conditions for a satisfying life."

In statistical terms, however, the correlation is quite substantial between IQ and occupations, when the latter are merely ranked in the order of persons' average judgment of the occupation's prestige. Various studies have shown correlations in the range of .50 to .70. This is sufficiently high that the mean differences between groups of persons in occupations arranged according to a prestige hierarchy (which is highly related to income) show highly significant differences in IQ or other mental test scores. In general, any two groups which differ in possessing what are perceived as "the good things in life" according to the criteria and values of our society, will be found on the average to differ significantly in IQ. Upward social mobility is related to IQ: the brighter children

in a family tend to move up in socioeconomic level and the least bright tend to move down. There are exceptions to the general rule. Those who are born to wealth tend to be less able than those who made it themselves--a quite predictable finding in term s of "regression to the mean." Usually the regression of ability is much greater than the regression of cumulated wealth. The most conspicuous exceptions, however, involve various disadvantaged minorities, whose social and economic positions are different from what one would predict in terms of IQ. For example, Negroes earn less income than whites of comparable IQ, education, family background, and work experience (Duncan et al., 1968). And American Indians, though considerably more impoverished than Negroes in the United States, score higher than Negroes on tests of intelligence and scholastic achievement (Kuttner, 1968). Oriental children, who generally score at least as high on IQ as white children, also score considerably higher than would be predicted from their socioeconomic status (SES). This appears especially true of low SES Oriental children, who perform on a par with middle-class white children on nonverbal tests (Lesser, Fifer, & Clark, 1965). In predicting scholastic performance in school and in college, however, the evidence indicates that IQ tests and scholastic aptitude tests work with about equal accuracy for all persons from whatever background. In this one respect, at least, the educational system seems to be one of the least discriminatory institutions in our society. For example, there is no evidence that IQ tests predict scholastic performance of Negro children less well than for white children, or that college entrance exams predict college grades less well for Negro than for white students (Jensen, 1968c; Stanley & Porter, 1967). The predictive validity of such tests could be lowered or changed, of course, by altering the curriculum such that the predictors would no longer be as relevant and other predictors might then

become more valid.

When groups are selected from the lower or upper extremes of the IQ distribution, the contrasts are enormous. A classic example is Terman's study of gifted children, selected in elementary school for IQs over 140, which constitutes the upper one percent of the population. These 1,528 children have been systematically followed up to middle age (Terman & Oden, 1959). The group as a whole greatly exceeds a random sample of the population on practically every criterion of a successful life, and not just intellectual criteria. On the average the Terman group have markedly greater educational attainments, have higher incomes, engage in more desirable and prestigous occupations, have many more entries in Who's Who, have brighter spouses, enjoy better physical and mental health, have a lower suicide rate, a lower mortality rate, a lower divorce rate, and have brighter children (their average IQ is 133). These results should leave no doubt that IQ is related to socially valued criteria.

Is Intelligence Inherited?

The evidence on this point is very clear. There is no doubt of a large genetic component in individual differences in IQ. The methodology of determining the heritability of intelligence (or other traits) and the results of the applications of these methods to the study of intelligence have been reviewed in detail elsewhere (Burt, 1958; Jensen, 1967, 1969a,b). Heritability (H) refers to the proportion of individual differences variance in a measurable trait, like intelligence, that can be atributed to genetic factors. 1-H, therefore, is the proportion of variance attributable to non-genetic factors. These non-genetic factors are both biological and psychological. Some substantial proportion of the non-genetic IQ variance is unidentifiable, that is, is due to random environmental effects and to

random stochastic biological processes in embryonic development.

The heritability of IQ as estimated from the average of all published studies of the subject is .80, which means that on the average the studies show that 80% of the population variance in IQ is attributable to genetic variation, and 20% to nongenetic factors. The value of .80 is merely an average of many studies which yield H values that range from about .60 to about .90. There is no single true value of the heritability of a trait. Heritability is not a constant, but a population statistic, and it can vary according to the test used and the particular population sample tested. H will be affected by the range of genetic and environmental variation that exists in the population. It should be noted that all the studies of the heritability of intelligence have been based on European and North American Caucasian populations. The results cannot strictly be generalized to other populations such as American Negroes. We would need to conduct heritability studies within the Negro population if we are to have any certainty that our IQ tests are measuring a genetic component to the same degree in the Negro as in the white population. (Determining H in both populations still would not answer the question whether the group mean IQ difference between Negroes and whites has a genetic component.)

Non-genetic or environmental sources of variance can be analyzed into two major components: variance attributable to differences between families in the population and variance attributable to differences within families. The sum of the between families and the within families variances constitutes the total of the nongenetic or environmental variance. Expressed as a proportion, it is $1 - \underline{H}_B = \underline{E}$, and, as already pointed out the average value of $\underline{H}_B$ reported in the literature is .80, making the average value of $\underline{E}$ = .20. The conceptually simplest method for estimating $\underline{E}$ is to obtain the correlation between identical (monozygotic) twins reared apart ($\underline{r}_{MZA}$) in uncorrelated environments (families). $\underline{E} = 1 - \underline{r}_{MZA}$. The correlation between identical twins reared together ($\underline{r}_{MZT}$) in the same family is used to estimate the within families environmental variance $\underline{E}_W = 1 - \underline{r}_{MZT}$. The between families variance is then $E_B = \underline{E} - \underline{E}_W$ or $\underline{r}_{MZT} - \underline{r}_{MZA}$. When these formulations are applied to all the relevant twin data reported in the literature, the average values they yield are $\underline{E}$ = .20, $\underline{E}_B$ = .12 and $\underline{E}_W$ = .08 (Jensen, 1967). Little, if any, of the $\underline{E}_W$ is controllable. Some of it is due to prenatal effects related to mother's age, health, accidental perinatal factors, ordinal position among other siblings, etc. In terms of our present knowledge, no prescription could be written for reducing $\underline{E}_W$. Some of it, in fact, is almost certainly due to random, stochastic developmental processes in the first weeks after conception, which means that even if we had perfect control over all the identifiable factors usually classified as environmental, genetically identical individuals would still show some differences. The between families component, $\underline{E}_B$, is probably much more attributable to what we commonly think of as environmental differences in terms of cultural-educational advantages, quality of nutrition, general health care, and the like.

Specific Comments on Genetics and IQ.

To say that an IQ test like the Stanford-Binet "measure present ability, not inborn capacity" is misleading. Surely it measures present ability or performance. But the fact that the heritability (H_B) of the Stanford-Binet IQ is about .80 in English and North American Caucasian populations also means that the test measures "innate capacity," if by this term we mean the individual's genotype for intellectual development. Since H is the proportion of variance in IQs (which are phenotypes) attributable to variance in genotypes, the square root of H represents the correlation between phenotype and genotype, and this correlation is about .90, a very high correlation indeed. (This is the correlation that exists after correction for attenuation, that is, test unreliability.) What the evidence on heritability tells us is that we can, in fact, estimate a person's genetic standing on intelligence from his score on an IQ test. If the correlation between phenotype and genotype were perfect (i.e., 1.00), a person's test score would, of course, be an exact index of his genetic potential. But since the correlation is only about .90, such statements can only be made on a probabalistic basis.

If education and culturally-derived motivation strongly affect intelligence test performance, then these factors should show up as part of the E variance, mostly E_B, i.e., between families environmental variance. Heritability studies, as pointed out, show the E variance to be only about 20% of the total and E_B only about 12% of the total. If group differences in IQ are to be explained in terms of educational and motivational factors, and if the heritability of IQ were the same in both groups, it would have to be assumed that all the members of one group differed from the mean of the other group by a constant amount in these motivational or other environmental variables. More will be said on this point in the later section on proposed genetic research.

The twin method may actually underestimate, rather than overestimate, the heritability of IQ. The reason is that there is considerable evidence that twins are more subject to prenatal stresses and nutritional disadvantages than singletons. This is reflected in the much lower birth-

weights of twins, the higher infant mortality of twins, and the fact that twins average 6 to 7 points lower in IQ than single-born children. One member of the twin pair is usually prenatally favored over the other, and this is especially true for monozygotic twins, as reflected in their differing birthweights. Birthweight of twins is positively correlated with later IQ (Willerman & Churchill, 1967). These prenatal differences, reflected in later IQ differences between the members of twin pairs, are very probably greater for twins than for singletons and therefore suggest a larger component of (prenatal) environmental variance in twins than in singletons. Thus the argument that the twin method of estimating heritability leads to an overestimate and thereby underestimates the environmental component is very weak. A stronger case can be made for just the opposite conclusion. The fact that the estimates of H from the twin methods are in close agreement with estimates based on other kinships indicates that the twin estimates are not very deviant in either direction. Indeed, it is the consistency of H estimates arrived at by different methods that makes them so impressive and reinforces their validity and scientific credibility (see Crow, 1969).

Cultural and educational differences are probably the most important non-biological sources of individual differences in intelligence, but they are not necessarily the most important non-genetic source of differences. It is likely that prenatal and nutritional factors are at least as important sources of variance as social-psychological factors. The sociological emphasis on the non-biological aspects of the environment has resulted in a relative neglect of probably important nutritional factors and maternal factors (age, health, diet, number of births, spacing of births,

etc.) which can affect the prenatal and early childhood development of the individual.

In reply to suggestions that our national IQ may be declining due to the possibility that the least able segment of the population is reproducing at a faster rate than the most able segment, some writers draw the familiar analogy between intelligence and physical stature. Both IQ and height are polygenetic traits and the same quantitative genetic model can be applied to both and can predict the various kinship correlations for IQ and height about equally well. It is also known that height, like intelligence, shows a positive correlation with socioeconomic status. Thus, if poor people have larger families than the well-to-do, we should expect the average height of the population to decrease over a number of generations. Exactly the same line of reasoning applies also in the case of intelligence. To counter this pessimistic prediction, it has been noted that despite what we should predict from simple genetic principles, the mean height of the population not only has not decreased in the past 200 years or so, but has in fact increased by a very significant amount. The increase, it is assumed, is due to environmental factors such as improved nutrition. And the implication is, of course, that intelligence, too, will increase over generations because of improvements in the environmental factors relevant to intellectual development. I believe this line of argument is weak and can lead to an unwarranted complacency about a possibly serious social trend.

First of all, Carter (1962) and Tanner (1965, 1968) have pointed out that much if not all of the increase in adult height in the past 200 years can be attributed to genetic factors, namely, the outbreeding effect. Increase in height is closely associated with the increase in

the population's mobility. The offspring of parents from different Swiss villages, for example, are taller than the offspring of parents born in the same village. This outbreeding effect, or hybrid vigor, tends to saturate or level off in the population in a few generations, as has already occurred with respect to height in the United States. Nutritional factors have their greatest effect on rate of growth rather than on final adult height. In World War I men reached their full adult height at age 26; today they attain their full height at 18 or 19.

Although it is true that height is positively correlated with socio-economic status (SES) and that low SES families are larger than high SES families, these facts alone are not sufficient to warrant the prediction that the mean height of the population should decline. It would have to be shown that the same numbers of low SES persons as high SES persons have offspring. When this point was investigated for intelligence, it was found that persons of below average IQ have larger families than persons of above average IQ, but that fewer of the below average ever marry or have any children at all (Higgins, & Reed, 1962; Bajema, 1963, 1966). The net result is a balance between the low and high IQ groups in the number of offspring they produce. This finding holds only for the white population of the U. S. of a generation ago. No studies of this type have been conducted in the U. S. Negro population. Since the bases for marriage and mate selection may be quite different in various subcultures, the results of investigation of this problem in one group cannot be generalized to other population groups with any confidence. The analogy with height is not convincing, since we have established only a negative correlation between height and family size, but have not taken into account the relative proportion of short and tall persons who never marry or produce offspring. Since we

know there is selective mating for height in our population (that is, taller persons are viewed as more desirable) it is likely that fewer short persons marry or reproduce and that therefore a similar equilibrium between reproductive rates of short and tall persons exists as in the case of low and high intelligence. As I have noted elsewhere (Jensen, 1968a, 1969a), certain statistics raise the question of whether Negro intelligence is declining relative to white intelligence as a result of more extreme differential birthrates in lower and upper social classes among Negroes than among whites. Negro middle- and upper-class families have fewer children than their white counterparts, while Negro lower-class families have more. In 1960, Negro women married to professional or technical workers had only 1.9 children as compared with 2.4 for white women in the same circumstances. Negro women of ages 35 to 44 who were married to unskilled workers had 4.7 children compared with 3.8 for non-Negro women in the same situation, and Negro women with incomes below $2000 per year averaged 5.3 children (Moynihan, 1966). This could mean that the least able segment of the Negro population is reproducing most rapidly, a condition that could alone produce and increase a genetic difference between the Negro and white populations in a few generations. The possible genetic and social implications of these trends have not yet come under investigation and there are no data at present which would warrant complacency about this important question.

Can genetic changes in a population take place only very slowly, so that selective pressures acting over several generations would be of negligible consequence? The answer, of course, depends largely on the degree of selective pressure. We already know enough to permit fairly accurate esti-

mates of genetic trends given certain criteria of selection. If selection were extremely rigorous, an enormous shift in the population mean would be possible, as can be inferred from the average IQ of the offspring of the Terman gifted group. The Terman subjects were selected for Stanford-Binet IQs of 140 and above; they had a mean of 152. There was no selection of their spouses, except by the normal assortative mating that occurs for intelligence in our society (i.e., a correlation of .5 to .6 between spouses' IQs). The offspring of the Terman gifted had an average IQ of 133 (Terman & Oden, 1959). This is more than two standard deviations above the mean IQ of children born to a random sample of the population. There is a regression from the selected parent generation toward the general population mean, but the regression happens only once, and the offspring of the selected parents will in turn have offspring without further regression, provided, of course, they do not mate outside the group of offspring from the selected parents. Rats have been bred for maze learning ability and it has generally required from six to nine generations of selection to produce two strains of rats whose distributions of maze learning scores are completely non-overlapping.

Is Race a Variable?

One of the easiest ways of avoiding the issue of race differences in intelligence is to make the claim that there is no such thing as race and therefore it is not a variable that can be related to any other variables. Thus, proponents of this view would claim that the concept of race is merely a myth, not a phenomenon that can be subjected to scientific study. This is, of course, utter nonsense. But it will pay to clarify the concept of race as it figures in comparative studies of intelligence.

There are two general definitions of race: the social and the bio-

logical (or genetic). Both are arbitrary, but this need not mean they are unreliable or lacking in precision. Although most of the studies of racial differences in intelligence are based on social definitions of race, it should be noted that there is usually a high correlation between the social and the biological definitions, and it is most unlikely that the results of the research would be very different if the investigators had used biological rather than social criteria of race in selecting groups for comparisons.

The social criteria of race are simple: they are the ethnic labels people use to describe themselves and the more obvious physical characteristics such as skin color, hair texture, facial features, and so on, by which persons roughly determine one another's "race." Admitted, the social definition is crude. It does not take account of "borderline" or ambiguous cases that are hard to categorize and which make for some unreliability in classification, and it does not take account of the fact that there are no pure racial types -- and especially in the case of American Negroes there is considerable racial admixture. Almost no American Negroes are of pure African descent; most have from 5% to 90% Caucasian genes, the average degree of admixture now being between 20% and 30%. Thus there is great genetic diversity within socially defined racial groups.

Does this make the social definition of race useless as a variable? No. In the first place, there is undoubtedly a high correlation between social and biological classification. That is to say, if one were to sort school children, for example, into three socially defined racial groups, Negro, Oriental, and Caucasian, one would find a very high concordance of classification if he used strict biological criteria based on the frequencies of blood groups, anthropometric measures, and other genetic poly-

morphisms. What one would not have obtained from the crude social classification is degrees of racial admixture. In other words, the major racial categories would be much the same whether constituted by social judgments or strict biological criteria. But if we wanted to go beyond this crude system of classification to make more refined differentiations, we would have to resort to biological criteria. Social judgments of degrees of racial admixture are quite unreliable. The broad categories, however, are reliable. They also qualify as variables in the sense that they show significant correlations with other variables such as IQ and scholastic performance. This is not to say that such correlations by themselves tell us anything about a biological or genetic basis for the correlation, which might be due to other environmental, social-class and cultural variables related to the socially defined racial classification. If the crucial variables in IQ differences are not racial classification per se, but other correlated environmental factors, then, at least in theory, one should be able to reduce the racial correlation with IQ to zero by partialling out the truly causal factors that are only incidentally correlated with both race and IQ. So far no one has succeeded in doing this as regards Negro-white comparisons. Every combination of environmental variables that anyone has partialled out has always left behind some significant correlation between race (socially defined) and IQ (Shuey, 1965). One can always claim that all the relevant environmental variables were not taken into account. This is a real weakness of such studies and they can be legitimately criticized on this score. It is largely for this reason that our understanding of racial differences will not be greatly advanced until more refined criteria of race based on biological criteria are employed. Specific proposals are made in a later section.

It is strange that those who claim that there are no genetic racial

differences in ability are often the most critical of studies that have employed the social criterion of race rather than more rigorous genetic criteria. If the observed IQ differences are due only to social factors, then the social definition of race should be quite adequate, and, in fact, should be the only appropriate definition. If it is then argued that the two socially defined racial groups being compared are not "pure" and that each group contains some genetic admixture of the other, it can only mean that the biological racial aspects of the observed IQ differences has been underestimated by comparing socially defined racial groups.

The biological definition of race is based on gene frequencies. Races are breeding groups which differ in the frequencies of one or more genes. A breeding group is one in which there is a higher proportion of matings among members of the group than of matings in which one member of the pair is from outside the group. Breeding groups result from relative degrees of geographical, racial, and cultural isolation of different population groups. The definition of race by these criteria is arbitrary only in the sense that differences in gene frequencies is a continuous variable, and where one wishes to draw the lines as criteria for classification purposes is not dictated by nature but by the taxonomic considerations of the investigator. Rather than thinking in terms of races, we should think in terms of groups with different gene frequencies. The question we would ask is whether various groups differing in gene frequencies also differ in IQ, other things being, in effect, equal. The major races are simply breeding populations that have a relatively high degree of inbreeding and differ from one another in the relative frequencies of many genes. They differ in so many known gene frequencies, in fact, that it seems highly

improbable that they would not also differ in the frequencies of genes related to behavioral traits such as intelligence.

A major block to clear thinking about race is to think of it as a kind of Platonic essence, independent of any particular population group. General statements about the mental abilities of the "white race," the "black race," "the yellow race," and so on, make no sense in terms of any studies that have yet been done or that seem at all feasible for the future. Strictly speaking, to ask if there are race differences in any characteristic is scientifically meaningless if what we mean by race is not clearly specified. All we can do is study samples selected from certain specified populations. These samples cannot be regarded as representative of some Platonic racial groups. They are merely representative (if properly selected) of the clearly specified population group from which they are selected.

We could ask, for example, whether a population subgroup that differs from the general population in its average response to the educational and occupational requirements of our society differs in its gene pool from other population subgroups which are more successful, and if so, are some of the genetic differences related to ability factors with high heritability?

Population subgroups which have immigrated are not necessarily representative of their native parent populations. Studies of racial or national groups in the United States, therefore, cannot be generalized abroad, and the reverse is also true. This does not mean, however, that meaningful comparative studies of various population subgroups within the United States are not feasible.

there are no
The notion that/genetic mental ability differences among population subgroups that differ in many other gene frequencies is, in principle, hard to defend. Populations that have been widely separated geographically or socially for many centuries and which have been exposed to climatic and cultural conditions that exert different selective pressures are almost certain to differ genetically in many ways. And, in fact, they do. Nearly every anatomical and physiological system studied has shown race differences. It is not at all necessary to invoke the factor of differential selective pressures to validate or explain some of these genetic differences, many of which confer no discernible advantage or disadvantage to survival or adaptation in any particular environment. A chemical substance, phenylthiocarbamide (PTC), is one illustration. To some persons PTC is completely tasteless; to others it has a very unpleasant bitter taste. Whether a person is a taster is determined by a single gene. This gene has markedly different frequencies in different racial groups. No one knows why this should be. Similarly, blood types have markedly different distributions in various racial groups, although it is not at all clear that one blood type is more advantageous than another in any given environment. In short, genetic diversity is the rule; genetic uniformity is the rare exception. By definition the gene pools of racial groups differ, and it is not at all an unreasonable hypothesis that genetic factors that condition behavioral development also differ.

Biological evolution generally is a slow process,
but genetic changes with respect to particular traits can occur relatively fast in response to selective pressures in the environment. In any case, biological evolution, whatever its rate, has resulted in marked genetic

differentiation of human populations. Concerning the one standard deviation average IQ difference between Negro and white American populations, one writer stated, "A review of present knowledge on interracial divergence in man makes it unlikely that a difference as large as the observed one is genetic." This hardly seems tenable in view of the fact that other traits show even greater racial differences than are found for intelligence. Height, like intelligence, is a polygenically inherited characteristic and is probably less subject to selective pressures than intelligence, and yet we find racial (and even national or regional) differences of more than one standard deviation. In fact, two racial subgroups on the African continent, the Pygmies and the Watusi, differ in height by five to six standard deviations. Obviously biological evolution has, in fact, been sufficient to create marked differences in genetic characteristics.

It is hard to imagine that there have not been different selection pressures for different abilities in various cultures and that these pressures would be as great for intelligence as for many physical characteristics which are known to differ genetically among racial groups. Individual differences in the abilities most relevant to a particular culture are highly visible characteristics and if they have consequences for the individual's status in the social hierarchy or the culture's system of rewards they will be traits subject to the genetic effects of sexual selection and assortative mating. If a trait is not very relevant to the demands of a particular culture it will not become highly visible, it will not be a basis for selective mating, and its genetic basis will not be systematically affected by pressures in the social environment.

Selective mating refers to the fact that certain characteristics are viewed as desirable in mate selection by virtually all members of the breeding population. The usual consequence is that those standing higher

on the desired trait will have greater opportunities for mating and reproduction while those at the lowest end of the distribution on the trait in question will be least likely to find a mate and to leave progeny. The net effect is to boost the mean value of the trait in the population. Assortative mating refers to the fact that like tends to marry (or mate with) like. It is sometimes an inevitable consequence of selective mating with respect to generally desirable traits, but also holds for traits which are merely subject to various individual preferences. It is noteworthy that of all measurable human characteristics the one with the highest coefficient of assortative mating (i.e., the correlation between mates) is intelligence. The correlation between spouses' IQs, for example, are around .5 to .6 in various studies, as contrasted with a correlation of .3 for height and of zero for fingerprints. The high degree of assortative mating for intelligence means that it is highly subject to genetic change through social influences. For example, the variance of the IQ distribution in the population would be reduced by approximately 20% if there were no assortative mating for just one generation. Assortative mating increases the variance of the characteristic in the population, and if there is selective mating (as well as assortative) for the characteristic, the individuals at the lower (least desirable) end of the distribution will be least likely to reproduce. The net effect is to raise the average of the population on the trait in question. Such trends have probably taken place with respect to different traits in different societies for many centuries. While sexual selection may be capricious and non-adaptive with respect to many physical characteristics (e.g., various societies have different criteria of beauty), selection is not likely to be capri-

tion in a given society. There has probably been quite strong and consistent selection for different patterns of ability in different cultures. A high degree of genetic adaptation to the demands of one environment might not constitute optimal adaptive capabilities to the demands of another, quite different, environment. As stated by Spuhler and Lindzey (1967, p. 413) in their chapter on the behavior-genetics of race difference:

> ...it seems to us surprising that one would accept present findings in regard to the existence of genetic, anatomical, physiological, and epidemiological differences between races and still expect to find no meaningful differences in behavior between races.

They continue to point out that there are

> enormous discrepancies between races in the efficiency with which culture is transmitted (for example, the difference between literate and nonliterate societies). Some of these differences are closely associated with race differences, have existed for many thousands of years, and presumably have been accompanied by very different selection pressures in regard to character potentially relevant to culture transmission, such as 'intelligence.'

Thus, it seems highly improbable that there have been no markedly differing selective pressures on different subpopulations even within the United States. The selective pressures on Negroes must have been

very different from those in European immigrant populations. The history of slavery suggests quite extreme selective factors, involving even the deliberate breeding of slaves for certain characteristics which were irrelevant or perhaps even negatively correlated with intellectual prowess. It would be surprising indeed if more than 300 years of slavery did not have some genetic consequences. But since the possible nature of these consequences are highly speculative and cannot be accurately inferred from historical accounts, this retrospective approach to the study of racial differences is too unreliable to be of much real scientific value. Direct genetical studies of present population groups can provide the only really satisfactory basis for the scientific study of genetic differences in abilities.

Are There Racial Differences in IQ?

In the United States persons classed as Negro by the common social criteria obtain scores on the average about one standard deviation (i.e., 15 IQ points on most standard intelligence tests) below the average for the white population. One standard deviation is an average difference, and it is known that the magnitude of Negro-white differences varies according to the ages of the groups compared, their socioeconomic status, and especially their geographical location in the United States. Various tests differ, on the average, relatively little. In general, Negroes do slightly better on verbal tests than on non-verbal tests. They do most poorly on tests of spatial ability, abstract reasoning and problem solving (Shuey, 1966; Tyler, 1965). Tests of scholastic achievement also show about one standard deviation difference, and this difference appears to be fairly constant from first grade through twelfth grade,

judging from the massive data of the Coleman study (1966). The IQ difference of 1 SD, also, is fairly stable over the age range from about 5 years to adulthood, although some studies have shown a tendency for a slight increase in the difference between 5 and 18 years of age. Another point that has been suggested, but which requires much more systematic investigation before any firm conclusions can be reached, is that there is a larger sex difference in IQs for Negroes than for whites (Bronfenbrenner, 1967). The presumed difference favors the females. The point is especially worthy of research because, if true, it would have considerable social and educational consequences, which would be especially evident in the upper tail of the IQ distribution. For example, if girls are a few IQ points higher than boys, on the average, one should expect a greatly disproportionate number of Negro girls to qualify, as compared with boys, in any selection based on cut-off scores well above the mean, such as selection for college. Assuming a general mean of 85, an SD of 15, and a normal distribution, a 5 point IQ difference between Negro boys and girls and a college selection cut-off score of 115, for example, we would expect the number of qualified girls to boys to be approximately in the ratio of 2 to 1.

A statistic which has been much less studied than the mean difference is the standard deviation (SD), that is, the measure of dispersion of scores within the distribution.

Most studies agree in finding a smaller SD in Negro than in white IQs. The single largest normative study of Stanford-Binet IQs in a Negro population, for example, found an SD of 12.4 as compared with 16.4 in the white normative sample (Kennedy, Van de Riet, and White, 1963). This study is based on a large sample of school children in five Southeastern

states and therefore may not be representative of the Negro population in other regions of the U.S. In general, however, most studies of Negro intelligence have found a smaller standard deviation than the SD of 15 or 16 generally found in white samples. The point is of some consequence in considering the relative merits of the opposing hypothesis relating to the causes of the observed average IQ difference between Negroes and whites, namely, the hypothesis of genetic equality versus the hypothesis of genetic differences. If the distribution of IQs in the Negro population does, in fact, have a smaller SD than in the white population, and if we hypothesize no genetic differences between the two populations, we must conclude that there is less variance due to environmental differences within the Negro group than within the white group. Since the genetic variance is hypothesized to be exactly the same in both groups, the difference in the variances (i.e., the square of the SD) of the groups must be all environmental variance. Thus, if the total variance of Negro IQs is less than of white IQs, the genetic equality hypothesis is forced to predict a higher heritability of IQ in the Negro population than in the white; that is to say, more of the variance in Negro IQs would have to be due to genetic factors. If a study of the heritability of IQ in the Negro population yielded a heritability coefficient equal to or less than that found in the white population, this finding would contradict the genetic equality hypothesis, at least as regards the equality of genetic variance in the two populations.

Let us take another look at the Kennedy et al. (1963) data in this connection, to see how the hypothesis of genetic equality of variances comes out for this one set of data comparing the distribution

of Negro IQs with the distribution of the white population sample on which are based the norms for the Stanford-Binet Intelligence Test. It will be recalled that the SDs for Negroes and whites were 12.4 and 16.4, respectively. The variances are thus $(12.4)^2 = 153.76$ and $(16.4)^2 = 268.96$. Now, the best estimate of the heritability of Stanford-Binet IQs in white population samples similar to that on which the Stanford-Binet was standardized is .80 (Jensen, 1969a). This means that 80% of the variance of the white IQ distribution is genetic variance: thus, .80 x 268.96 = 215.17 is the white genetic IQ variance. But this is still greater than the total Negro IQ variance. The heritability of IQ in the white group would have to be assumed to be .57 for the white genetic variance to equal the total IQ variance of the Negro group, and surely some of this total variance is non-genetic. Furthermore, no reported study of the heritability of Stanford-Binet IQs is as low as .57. Thus, a hypothesis of genetic equality with respect to variances leads to highly untenable conclusions when applied to the data of Kennedy et al. (1963). By any canon of statistical and logical reasoning one is forced to reject the hypothesis that the distributions of genotypes for intelligence are equivalent in these two samples. By assuming genetic equivalence, one simply cannot make any sense out of the available data. This is not to say that one cannot question the data with respect to every parameter that is involved in this line of reasoning.[1] But if one accepts the validity of the heritability estimates in the white population and the SDs given by Kennedy et al., it logically follows that a genetic equivalence hypothesis is untenable. It is, of course, statistically unwarranted to generalize this conclusion beyond the populations sampled in the study by Kennedy et al. The causes of the lesser variance

of IQ in the Negro group is not known. One can only speculate and suggest hypotheses. From the evidence on the white population, for example, we know that some 15 to 20 percent of the total variance is attributable to assortative mating for intelligence; if the correlation between mates' IQs was markedly reduced, the white IQ variance would be substantially reduced. (Variance due to assortative mating is all genetic variance.) Also, the covariance of heredity and environment (i.e., there is some correlation between children's genotypes for intellectual development and the quality of the environment in which they are reared) constitutes some 5 to 10 percent of the total IQ variance in the white population. If environments were more similar, there would be less covariance and this source of variance would be diminished in the total. We could find out if these factors or others, or some combination of factors, are responsible for the lesser variance in the Negro population only by carrying out complex heritability studies in the Negro population.

A point that should be stressed is the fact that neither the white nor the Negro population, by common social classification, is genetically homogeneous. It has already been noted that the American Negro is not of pure African ancestry but has, on the average, an admixture of 20% to 30% Caucasian genes, varying from less than 5% in some regions of the country to 40% or 50% in others (Reed, 1969). The white population contains many different subgroups which most probably differ genetically in potential for intellectual development. To point to one particular subgroup of one socially defined racial population as being higher or lower in IQ than some subgroup in another racial population proves nothing other than the fact that there exists an overlap between the racial groups. The fact

that relatively large mean IQ differences are found between certain subgroups within the same race does not mean that these differences must be entirely of environmental origin and that therefore racial differences of similar magnitude must also be entirely attributable to environment.

Finally, it should be noted that IQ tests are taken by individuals. There is no such thing as measuring the IQ of a group as a group. Individuals' IQs are obtained as individuals. The basis on which individuals may be grouped is a separate issue, depending upon the purposes of the investigator. When test scores are grouped according to some criteria of racial classification, we find mean differences between the groups. If we group test scores by some criteria of socioeconomic status, we find mean differences between the groups. Conversely, if we group persons by levels of IQ, we find the groups differ in their proportions of persons of different races and social classes.

Are Race Differences Important?

There is, of course, nothing inherently important about anything. Race differences in intelligence are important only if people think these differences, or their consequences, are important. It so happens that in our society great importance is given to these differences and their importance is acknowledged in many official public policies. Racial inequality in educational and occupational performance, and in the social and economic rewards correlated therewith, is today clearly one of the uppermost concerns of our nation.

Most persons are not concerned with those racial characteristics that are patently irrelevant to performance. The real concern results from the observed correlation between racial classification and educational and occupational performance. Persons who feel concerned about

these observed differences demand an explanation for the differences. It is apparently a strongly ingrained human characteristic to need to understand what one perceives as a problem, and to ask for answers. People inevitably demand explanations about things that concern them. There is no getting around that. We have no choice in the matter. Explanations there will be.

But we do have a choice of essentially two paths in seeking explanations of intelligence differences among racial groups. On the one hand, we can simply decree an explanation based on prejudice, or popular beliefs, or moral convictions, or one or another social or political ideology, or on what we might think it is best for society to believe. This is the path of propaganda. Or, on the other hand, we can follow the path of science and investigate the problem in the same way that any other phenomena would be subjected to scientific study. There is nothing to compel us to one path or the other. This is a matter of personal preference and values. And since persons differ markedly in their preferences and values, we will inevitably see both of these paths being followed for quite some time. My own preference,

is for a scientific approach to the study of these phenomena. It is certainly the more interesting and challenging intellectually. And our experience tells us that the scientific approach, by and large, leads to more reliable knowledge of natural phenomena than any other method that man has yet devised. If solutions to educational problems depend upon recognizing certain psychological realities in the same sense that, say, building a workable spaceship depends upon recognizing certain physical realities, then surely we will stand a better chance of improving education for all children by choosing the path of scientific inves-

tigation. In facing the issue of race differences in abilities we should heed the statement of John Stuart Mill:

> If there are some subjects on which the results obtained have finally received the unanimous assent of all who have attended to the proof, and others on which mankind have not yet been equally successful; on which the most sagacious minds have occupied themselves from the earliest date, and have never succeeded in establishing any considerable body of truths, so as to be beyond denial or doubt; it is by generalizing the methods successfully followed in the former enquiries, and adapting them to the latter, that we may hope to remove this blot on the face of science.

Once we subscribe to a scientific approach, we are obligated to act accordingly. This means, for one thing, that we entertain alternative hypotheses. To entertain a hypothesis means not just to pay lip service to it or to acknowledge its possible merit and let it go at that. It means to put it into a testable form, to perform the test, and report the results with information as to the degree of statistical confidence with which the hypothesis in question can be accepted or rejected. If we can practice what is called "strong inference," so much the better. Strong inference consists of formulating opposing hypotheses and pitting them against one another by actually testing the contradictory predictions that follow from them. This is the way of science. How much of our educational research, we may ask, has taken this form? How much of the research that we see catalogued in the already gargantuan ERIC bibliography on the causes of the educational handicaps of children called

culturally disadvantaged has followed this path? The only sensible conclusion one can draw from a perusal of this evidence is that the key question in everyone's mind about racial differences in ability -- are they genetic? -- has, in effect, been ruled out as a serious alternative hypothesis in the search for the causal factors involved in inequalities of educational performance. Sundry environmental hypotheses are considered, but rarely, if ever, are alternative genetic hypotheses suggested. If a genetic hypothesis is mentioned, it is usually for the sake of dismissing it out of hand or to point out why it would be impossible to test the hypothesis in any case. Often, more intellectual ingenuity is expended in trying to find reasons why a particular genetic hypothesis could not be tested than in trying to discover a way of formulating the hypothesis so that it could be put to a test. The emotional need to believe that genetic factors are unimportant in individual or group differences in ability can be seen in many statements by dedicated workers in those fields of psychology and education most allied to the problems of children called disadvantaged. For example, Dr. Bettye Caldwell, a prominent worker in compensatory and early childhood education has noted:

> Most of us in enrichment...efforts -- no matter how much lip service we pay to the genetic potential of the child -- are passionate believers in the plasticity of the human organism. We need desperately to believe that we are all born equalizable. With any failure to demonstrate the effectiveness of compensatory experiences offered to children of any give age, one is entitled to conclude parsimoniously that perhaps the enrichment was not offered at the proper time. (Quoted by Baratz & Baratz, 1969)

But genetic factors in rate of development are never considered as a possible part of the explanation.

It is important not to evaluate persons in terms of group membership if we are to insure equality of opportunity and social justice. All persons should be treated as individuals in terms of their own merits, if our aim is to maximize opportunities for every person to develop his abilities to their fullest capacity in accord with his own interests and drives. But the result of individual selection (for higher education, better jobs, etc.) makes it inevitable that there will be unequal representation of the parent populations in any subgroup that might be selected whenever there are average differences between parent populations.

Many questions about the means of guaranteeing equality of educational opportunity are still moral and political issues at present. When there is no compelling body of scientific evidence on which policy decisions can be based, such decisions must be avowedly made in terms of one's personal social philosophy and concepts of morality. Many goals of public policy must be decided in terms of values. The results of research are of greatest use to the technology of achieving the value-directed goals of society. The decision to put a man on the moon was not a scientific decision, but once the decision was made the application of scientific knowledge was necessary to achieve this goal. A similar analogy holds for the attainment of educational goals.

Can Race Differences Be Researched?

It is sometimes argued that even though it is not unreasonable to hypothesize genetic racial differences in mental ability, we cannot know the direction or magnitude of such genetic differences and the problem

is much too difficult and complex to yield to scientific investigation. Therefore, the argument often continues, we should go on pretending as though there is no question of genetic differences, as was officially stated by the U. S. Office of Education in 1966: "It is a demonstrable fact that the talent pool in any one ethnic group is substantially the same as that in any other ethnic group."

First, we will never know to what extent research can yield answers on a subject unless we at least try our best to do the research. It is doubtful that any major scientific advances could have been made in any field if it were decided beforehand that the problems could not be researched. I cannot agree that a scientific approach should be restricted to only the easy problems. If all the necessary methodology for studying the genetics of race differences in psychological characteristics is not yet sufficiently developed, this should not be surprising, since so little effort has been made thus far. The methodology of a field of inquiry does not grow in a vacuum. Scientists do not first develop a complete methodology for the investigation of a complex area and then apply it all at once to get the final answers. An appropriate methodology evolves as a result of grappling with difficult problems in the spirit of scientific research. Darwin's theory of evolution did not begin with a fully developed methodology adequate to prove the theory, nor did the theory of the inheritance of acquired characteristics -- a theory which was later disproved after the development of an adequate methodology, a methodology which would not have developed in the absence of attempts to research this theory. No one would have been inclined to invent the necessary research methods in the absence of the problems these methods were needed to solve. One critic states "The scientific problem {of genetic race differences in ability} itself seems of dubious validity, if one con-

siders how great are the difficulties..., at least on the basis of present techniques." The same statement could have been made about research on the theory of evolution, the atomic theory, the gene theory, and so on. We do not expect any single study or experiment to reduce all the uncertainty about a complex subject to absolute zero in one bold stroke! But as in dealing scientifically with most other complex phenomena, we should not regard ourselves as so intellectually impotent as to be unable to gradually chip away at the heredity-environment uncertainty with whatever tools that scientists can muster or devise with their present knowledge and ingenuity.

What are some of the thinking blocks in this area? One is the frequent failure to distinguish between raw facts, on the one hand, and inference from the facts in terms of some hypothesis, on the other. The Society for the Psychological Study of Social Issues (SPSSI), for example, in a press release (May 2, 1969) criticizing my article in the Harvard Educational Review (Jensen, 1969a), stated, "There is no direct {italics mine} evidence that supports the view that there is an innate difference between members

of different racial groups." Of course there is not direct evidence, nor can there be direct evidence if by "direct" we mean evidence that is immediately palpable to our physical senses. The gradual disappearance of ships over the horizon is not direct evidence of anything, but it can be interpreted in terms of the hypothesis that the earth is round. It would be harder to explain if we hypothesized that the earth is flat. So even as relatively simple an hypothesis as that the world is round cannot be proved by direct evidence, but depends upon logical inference from diverse lines of evidence. If all that was needed was direct evidence, even a monkey would know that the world is round, in the same sense that it knows that a lemon is sour. The substantiation of an hypothesis in science depends upon objective evidence but does not necessarily depend upon direct evidence alone.

Another inhibition to thought on this topic is the notion that before research can yield any answers, the environment must be absolutely equal for all groups involved in comparisons. The SPSSI statement went so far as to say that "...a more accurate understanding of the contribution of heredity to intelligence will be possible only when social conditions for all races are equal and when this situation has existed for several generations." Since no operationally testable meaning is given to "equal" social conditions, such a statement, if taken seriously, would completely preclude the possibility of researching this important question, not just for several generations, but indefinitely. Actually, large environmental differences between racial groups can be revealing when the environmental ratings are positively correlated with IQ or scholastic performance within the groups but show a negative correlation between the groups. If group A on the average has a poor environment in terms of variables claimed to be important to intellectual development and group B has a good environment, and if group A performs better

than group B on intelligence tests which are appropriate to the experience of both groups, this is evidence that some factors other than the measured environmental variables are involved in the relatively higher intellectual performance of group A as compared with group B. If environmental factors cannot be found that will account for the difference, it is presumptive evidence in favor of the genetic hypothesis. Genetical tests of the hypothesis are preferable, of course. (These are discussed in a later section). But what one also looks for are consistencies among various lines of evidence, especially lines of evidence that lead to opposite predictions from different hypotheses.

Many investigators now would question the view that the lack of early stimulation in the preschool years can be counted among the chief causes of the poorer IQ performance of Negro children, since when children are grouped in several categories according to their parents' socioeconomic status, the Negro children in the highest SES category still score two to three IQ points below white children in the lowest SES level (Shuey, 1966). Thus, what we generally think of as a reasonably good environment is apparently not sufficient to equalize the performance of Negro and white groups.

Such findings lead to hypothesizing increasingly subtle and hard to measure environmental effects. But it should be recognized that at present most of the environmentally "damaging" effects that are assumed to be accountable for performance differences are hypothetical and not factual. Poor self-concept and alienation are among the currently prevailing explanations, but what has not yet been satisfactorily explained is why such general motivational dispositions should affect some cognitive abilities so much more than others. Performance is not uniformly low on all tasks, by any means. There are distinct high and low points

in the profile of various abilities in different ethnic groups (Stodolsky & Lesser, 1967), and no one has yet attempted to explain how such profile differences, which are invariant across social classes, could come about as a result of differences in generalized attitudes and motivation in the test situation.

Finally, unnecessary difficulties arise when we allow the scientific question to become mixed up with its possible educational, social, and political implications. The scientific question and its solution should not be allowed to get mixed up with the social-political aspects of the problem, for when it does we are less able to think clearly about either set of questions. The question of whether there are or are not genetic racial differences in intelligence is independent of any questions of its implications, whatever they may be. But I would say that the scientific question should have priority and the answer should be sought through scientific means. For although the answer might have educational and social implications, and there are indeed grave educational and social problems that need to be solved, we must first understand the causes of problems if we are to do anything effectively toward solving them. Gaining this knowledge is a scientific task. As it is accomplished, we are then in a better position to consider alternative courses of action and evaluate their feasibility and desirability in terms of society's values and goals. This moves the problem into the realm of public policy, where all the answers cannot be scientifically derived. But policy cannot be wisely or effectively formulated unless it is informed by the facts. No matter how well-intentioned it may seem to be, it can only be less effective and less beneficial if it is based on false premises or in contradiction of reality.

Genetic Research to Reduce the Heredity-Environment Uncertainty

Today there is virtually no uncertainty among those who have attended to the evidence that individual variation in intelligence is predominantly conditioned by genetic factors and that environmental factors account for a lesser proportion of the phenotypic variance. One can point to variations among studies that have estimated the heritability of intelligence. Such variations in estimates of the proportion of variance attributable to genetic factors are to be expected in view of the great variety of populations sampled and the differences among the variety of tests of mental ability that have been used. Despite these expected variations in heritability estimates, it is important to note that no major study contradicts the conclusion that heredity contributes something more than twice as much to the variance in IQ as environment in white European and American populations. (We do not have good heritability data on other populations.)

The term "heredity-environment uncertainty" refers mainly to the question of race differences in intelligence. The answer to this

question is still in the realm of uncertainty in terms of the normal scientific meaning of this word. Absolute certainty is never attained in an empirical science. Absolute certainty can be had only in pure mathematics, the certainty of which rests upon the fact that pure mathematics is, as Bertrand Russell pointed out, just one vast tautology. Empirical science deals in probability statements, and "certainty" refers to a high degree of probability that a proposition is "true," meaning that certain objective consequences can be predicted from the proposition with a stated probability. A decisive increase in this probability with respect to any given scientific proposition rarely results from a single experiment or discovery. I take exception to the impression that might be given by some writers that unless a scientific study can be perfect and 100% certain, we cannot know anything. This is not how scientific knowledge advances. We do not devise perfect methods or obtain complete answers on the first try. Certainty, in the sense of probability, is generally increased very incrementally in science. Research aims to add reliable increments to statements of probability.

This we must continue to do with respect to the question of genetic race differences in intelligence. It is still an open question by all reasonable scientific standards. The existing evidence is in all cases sufficiently ambiguous, due largely to the confounding of racial and environmental factors, as not to permit statements with a sufficiently high probability such that all reasonable and qualified persons attending the evidence will agree that it is conclusive. The issue of genetic race differences may be likened to theories of the moon's craters -- whether they were caused by volcanic eruptions or by the impact of

meteors. All the evidence obtainable by astronomers could support either interpretation, and different scientists could argue for one theory or the other. A substantial increment could be subtracted from this uncertainty only by obtaining new evidence not obtainable through telescopic study, namely, directly obtaining and analyzing material from the surface of the moon.

I believe that, similarly, the heredity-environment uncertainty about race differences in IQ will be substantially reduced only by obtaining new evidence -- new kinds of evidence. Exclusive reliance on anthropological, sociological, and psychological evidence would probably not substantially advance our knowledge. I believe that application of the methods of biometrical genetics (also called population genetics or quantitative genetics) to the question of race differences will substantially reduce our uncertainty.

Someone suggested that the only way one could prove race differences in intelligence would be to dye one member of a pair of white identical twins black and adopt it out to a Negro family while the co-twin is reared by a white family. How much difference would it make in their IQs? Better yet is the suggestion of Professor Arthur Stincombe (1969): find pairs of identical twins in which one member of each pair is Negro and one is white, separate them at birth and rear them in Negro and white families and see how their IQ differences compare with those found for twins where both are of the same race! These suggestions sound ridiculous; one is unfeasible and the other is impossible. Yet as conceptual experiments they are good, because they suggest the necessary ingredients of the information we must obtain to reduce the heredity-environment

uncertainty. Both examples rightly recognize skin color (and, by implication, other visible racial features) as a part of the individual's environment. They are based on comparing genetically equivalent persons reared in different environments. Another possibility consists of rearing genetically and racially different persons in essentially similar environments -- including the factor of skin color, etc. Is such a study possible? Yes.

Geneticists already know the frequencies of a large number of genetically independent blood groups in European and African populations. On the basis of such data, it is entirely possible to determine the proportion of Caucasian genes in a population sample of Negroes, socially defined. Furthermore, it should be possible by the same means to classify individuals on a probabilistic basis in terms of their relative proportions of African and Caucasian genes. Since the average admixture of Caucasian genes for American Negroes is between 20 and 30 percent, there should be enough variance to make it possible to assign large numbers of individuals to at least several categories according to their amount of admixture, and the probable error in classification could be quite definitely specified. A sufficient number of blood groups or other genetic polymorphisms with known frequency distributions in African and Caucasian populations would have to be employed to ensure a high degree of statistical certainty that the categories represented different degrees of genetic racial admixture. A wide range of admixtures probably exists among Negroes living in highly similar environments, so that it should be quite possible in such a study to obtain samples which do not differ across the admixture categories in a number of socioeconomic or other environmental indices. What about skin color? It is polygenetic and is very imperfectly correlated with the amount of Cau-

casian admixture. Individuals, for example, whose genes are derived in equal (50-50) proportions from African and Caucasian ancestors evince the full range of skin colors from white to black, including all the shades between. This makes it possible statistically to control the effect of skin color; that is, one can compare a number of persons all of whom have the same skin color but different degrees of African/Caucasian admixture, or conversely, the same degree of admixture but different skin colors. (Skin color can be quantified precisely and objectively by means of a photoelectric device which measures reflectance.) The question, then, would be: do the mean IQs (or any other mental ability tests) of the several categories of racial admixture differ significantly and systematically? The genetic equality hypothesis would predict no difference; the genetic inequality hypothesis would predict a difference between the groups.

A further refinement, in order to ensure greater equality of environmental conditions across the admixture categories, including prenatal environment, would be to include in the study a large number of half-siblings all related through the mother and reared together. Some half-siblings will inevitably fall into different admixture categories. Do they differ significantly on mental tests when skin color is controlled? Birth order, maternal age, and other factors would have to be noted, but in large samples these factors would probably tend to be random with respect to racial admixture. One would also want a white control group with no African admixture in order to rule out the remote possibility that the blood groups themselves are causally related to IQ, since they are intended in this study only as genetic markers or indices of racial admixture. Such a study would go further toward answering the question of

Negro-white genetic differences in intelligences than the sum total of all the other studies that we now have.

The possibility has been suggested of using genetic linkages for studying the inheritance of intelligence and race differences, but evaluation of its potential merits will have to be decided by geneticists. If the genes for some clearly identifiable physical trait are located on the same chromosome as the genes for some measurable mental ability, we should expect to find a marked correlation in the population between the appearance of the physical characteristic and the mental attribute whose genes share the same chromosome. The physical characteristic would thus serve as an objective genetic marker for the mental trait.

The major difficulty with this approach may be that what we call intelligence is so polygenetic that the relevant genes are carried on most or all of the chromosomes, so that specific linkages could never be established. If intelligence consists of a large number of subabilities, each of which is conditioned independently by a very limited number of genes which are carried on a single chromosome, then it may be possible to study linkages, provided we can reliably measure the subabilities. I have described elsewhere how psychologists might make their measurements of abilities of greater interest and value to researchers in genetics (Jensen, 1968c). Briefly, it would consist of the fractionation of mental abilities to the most extreme limits that reliability of measurement will permit, and then seeing if these subabilities show any signs of relatively simple genetic inheritance (such as showing Mendelian ratios) or genetic linkages.

Are there any known linkages between physical and mental characteristics in the normal distribution of intelligence? I do not know of

any established examples. We should begin looking for such possible mental linkages with blood groups, biochemical variations, and other physical traits. One set of interesting findings concerns the association between uric acid level in the blood and intellectual achievement. Whether this is an instance of genetic linkage or whether there is a causal connection between uric acid and brain functions is not yet established. Stetten and Hearon (1958) reported a correlation between serum uric acid concentration and scores on the Army intelligence test of 817 inductees. A study of serum urate levels of 51 University of Michigan professors found a positive correlation with drive, achievement, and leadership (Brooks and Mueller, 1966), and high school students have been found to show a similar relationship (Kasl, Brooks, & Cobb, 1966). It would be interesting to know if these correlations are found within other racial groups and also if there are differences between groups in serum uric acid levels. Every bit of such various kinds of information, if it points consistently in the same direction, reduces to some extent the heredity-environment uncertainty.

There are other promising approaches to this problem through biometrical genetics, but explication of the technical aspects of these methods is clearly beyond the possible scope of the present discussion.

Implications for Education

Since educators have at least officially assumed that race and social class differences in scholastic performance are not associated with any genetic differences in growth rates or patterns of mental abilities but are due entirely to discrimination, prejudice,

inequality of educational opportunity, and factors in the child's home environment and peer culture, we have collectively given little if any serious thought to whether we would do anything differently if we knew in fact that all educational differences were not due solely to these environmental factors.

There have been and still are obvious environmental inequities and injustices which have disfavored certain minorities, particularly Negroes, Mexican-Americans, and American Indians. Progress has been made and is continuing to be made to improve these conditions. But there is no doubt still a long way to go, and the drive toward further progress in this direction should be given top priority in our national effort. Education is one of the chief instruments for approaching this goal. Every child should receive the best education that our current knowledge and technology can provide. This should not imply that we advocate the same methods or the same expectations for all children. There are large individual differences in rates of mental development, in patterns of ability, in drives and interests. These differences exist even among children of the same family. The good parent does his best to make the most of each child's strong points and to help him on his weak points but not make these the crux of success or failure. The school must regard each child, and the differences among children, in much the same way as a good parent should do.

I believe we need to find out the extent to which individual differences, social class differences, and race difference in rates of cognitive development and differential patterns of relative strength and weakness in various types of ability are attributable to genetically conditioned biological growth factors. The answer to this question might imply differences in our approach to improving the education of all

children, particularly those we call the disadvantaged, for many of whom school is now a frustrating and unrewarding experience.

Individuals should be treated in terms of their individual characteristics and not in terms of their group membership. This is the way of a democratic society, and educationally it is the only procedure that makes any sense. Individual variations within any large socially defined group are always much greater than the average differences between groups. There is overlap between groups in the distributions of all psychological characteristics that we know anything about. But dealing with children as individuals is not the greatest problem. It is in our concern about the fact that when we do so, we have a differentiated educational program, and children of different socially identifiable groups may not be proportionately represented in different programs. This is the "hang-up" of many persons today and this is where our conceptions of equal opportunity are most likely to go awry and become misconceptions.

Group racial and social class differences are first of all individual differences, but the causes of the group differences may not be the same as of the individual differences. This is what we must find out, because the prescription of remedies for our educational ills could depend on the answer.

Let me give one quite hypothetical example. We know that among middle-class white children, learning to read by ordinary classroom instruction is related to certain psychological developmental characteristics. Educators call it "readiness." These characteristics of readiness appear at different ages for different kinds of learning, and at any given age there are considerable individual differences among chil-

dren, even among siblings reared within the same family. These developmental differences, in middle-class white children, are largely conditioned by genetic factors. If we try to begin a child too early in reading instruction, he will experience much greater difficulty than if we waited until we saw more signs of "readiness." Lacking readiness, he may even become so frustrated as to "turn off" on reading, so that he will then have an emotional block toward reading later on when he should have the optimal readiness. The readiness can then not be fully tapped. The child would have been better off had we postponed reading instruction for six months or a year and occupied him during this time with other interesting activities for which he was ready. Chances are he would be a better reader at, say, 10 or 11 years of age for having started a year later, when he could catch on to reading with relative ease and avoid the unnecessary frustration. It is very doubtful in this case that some added "enrichment" to his preschool environment would have made him learn to read much more easily a year earlier. If this is largely a matter of biological maturation, then the time at which a child is taught in terms of his own schedule of development becomes important. If, on the other hand, it is largely a matter of preschool environmental enrichment, then the thing to do is to go to work on the preschool environment so as to make all children equally ready for reading in the first grade. If a child's difficulty is the result of both factors, then a combination of both enrichment and optimal developmental sequencing should be recommended.

There is a danger that some educators' fear of being accused of racial discrimination could become so misguided as to work to the disadvantage of many minority children. Should we deny differential educational treatments

to children when such treatment will maximize the benefits they receive from schooling, just because differential treatment might result in disproportionate representation of different racial groups in various programs? I have seen instances where Negro children were denied special educational facilities commonly given to white children with learning difficulties, simply because school authorities were reluctant to single out any Negro children, despite their obvious individual needs, to be treated any differently from the majority of youngsters in the school. There was no hesitation about singling out white children who needed special attention. Many Negro children of normal and superior scholastic potential are consigned to classes in which one-fourth to one-third of their classmates have IQs below 75, which is the usual borderline of educational mental retardation. The majority of these educationally retarded children benefit little or not at all from instruction in the normal classroom, but require special attention in smaller classes that permit a high degree of individualized and small group instruction. Their presence in regular classes creates unusual difficulties for the conscientious teacher and detracts from the optimal educational environment for children of normal ability. Yet there is reluctance to provide special classes for these educationally retarded children if they are Negro or Mexican-American. The classrooms of predominantly minority schools often have 20 to 30 percent of such children, which handicaps the teacher's efforts on behalf of her other pupils in the normal range of IQ. The more able minority children are thereby disadvantaged in the classroom in ways that are rarely imposed on white children for whom there are more diverse facilities. Differences in rates of mental development and in potentials for various types of learning will not disappear by being ignored. It is up

to biologists and psychologists to discover their causes, and it is up to educators to **create** a diversity of instructional arrangements best suited to the full range of educational differences that we find in our population. Many environmentally caused differences can be minimized or eliminated, given the resources and the will of society. The differences that remain are a challenge for public education. The challenge will be met by making available more ways and means for children to benefit from schooling. This, I am convinced, can come about only through a greater recognition and understanding of the nature of human differences.

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Footnote (p. 32)

For example, one need not accept the IQ scale as the most appropriate. If it could be argued and demonstrated that some transformation of the IQ scale produced more orderly and lawful data in studies of heritability, in the degree of normality of the distribution of scores, and in more closely approximating a genetic model, then such a transformation would be justified. It could very well affect the variances of the distributions in different population subgroups. Berkeley geneticist Dr. Jack King, for example, has suggested that if we assume that the factors (genetic and environmental) that affect intelligence do not behave additively but interact multiplicatively (i.e., a factor adds or subtracts a given _percentage_ to the total measure rather than a fixed _amount_) a logarithmic transformation of the IQ scale is theoretically justified. In the multiplicative model, the logarithm of the observed measure is normally distributed. The logarithmic transformation in fact makes the IQ distribution more normal (Gaussian) in a number of studies, and it tends to equalize the variances of the Negro and white distributions, although it also has the effect of pulling their means slightly further apart. The proper transformation is 100 (1 + ln IQ/100), which leaves the general population mean at IQ 100. (ln is the natural logarithm.) Past studies of the heritability of intelligence should be re-analyzed using this logarithmic transformation of the IQ scale to see if it gives a closer and more parsimonious fit to a polygenic model.